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(56) Documents Cited
GB 2298936 A GB 2264370 A GB 2252846 A
GB 2073455 A EP 0619568 A EP 0285056 A
WO 89/08300 A US 4659909 A

(58) Field of Search
UK CL (Edition O) G3N NGBC1 NGK2 NGL NG1AX NG1A1 NG1A3 NG1A5 NG1A9, G3R RBQ42
INT CL^6 F24C 7/08

(54) Heating apparatus with programmable controller

(57) The apparatus comprises at least one heating device, such as "hobs" 2-5 and at least one programmable controller 10. The programmable controller receives at least one type of signal on lines 13-18, and may control, separately, one or more heating devices. The signals may be data, or warnings. Data signals include readings of temperature or pressure, or the level of energy supplied to a heat transfer means. Warning signals may include the absence of an operator, smoke detection, or a physical state falling outside prescribed limits. The programmable controller generates at least one type of control signal in response to one or more of the received signals. The control signal controls the level of energy supplied to at least one of the heating devices. and/or issues a warning which may be visual or audible and/or control the flow of energy to the heating device. The programmable controller may be provided with a visual display panel and a programming means.

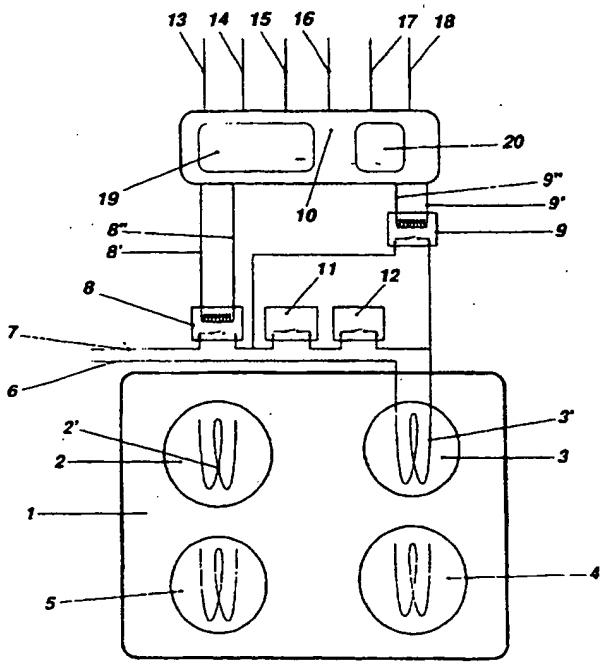

Figure 1.

GB 2 318 650

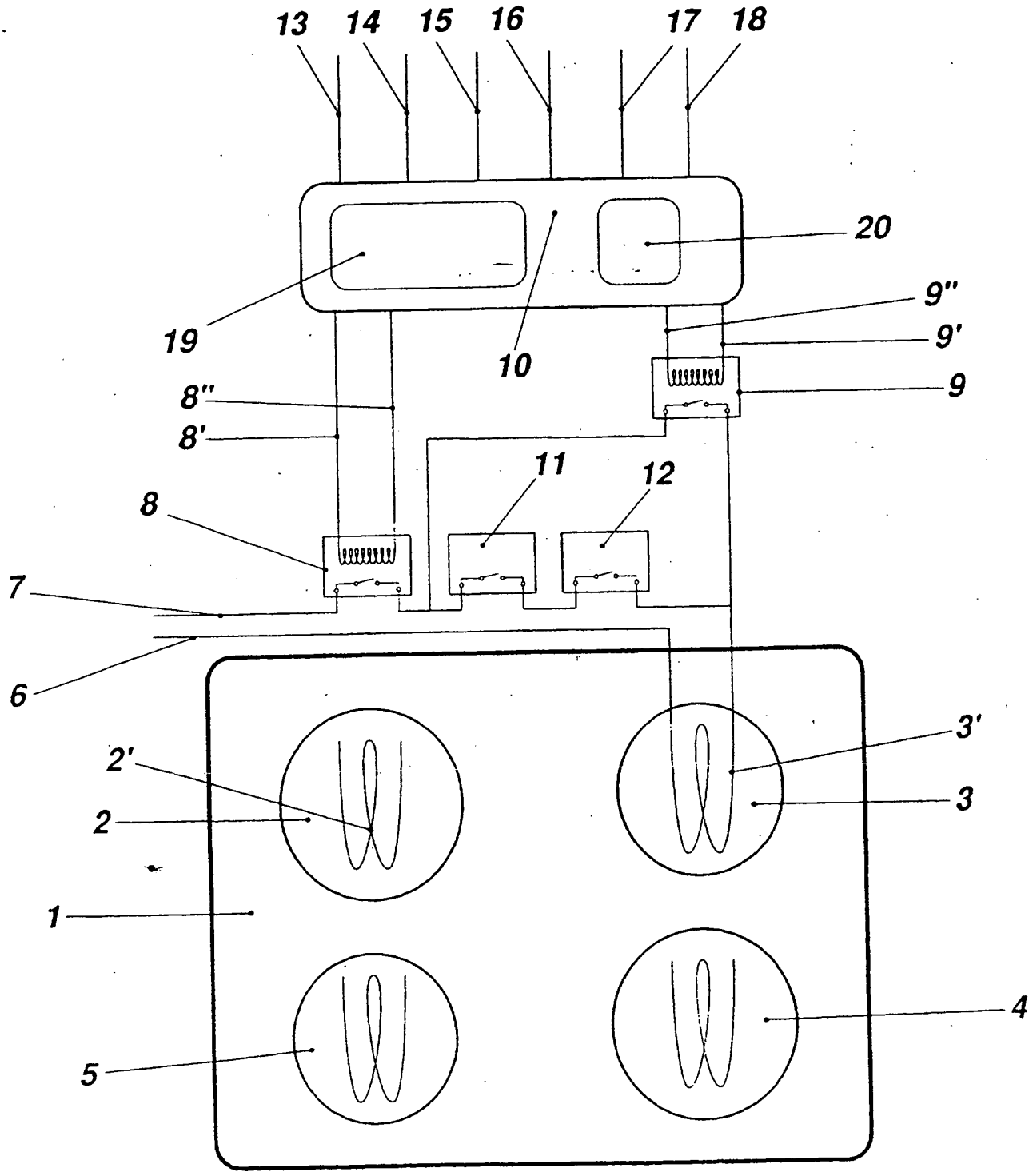

Figure 1.

Controlled heat transfer device.

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We, Alan Brown, a British subject of 4, Grange Crescent, Sunderland, Tyne & Wear, SR2 7BN and John Nolan, a British subject of 49, Kewferry Road, Northwood, Middx. HA6 2PE do hereby declare the invention for which we pray a patent may be granted to us and the method by which it is to be performed, to be particularly described in and by the following statement :-

This invention relates to heat transfer devices that are capable of being controlled. Advantages of control include possibilities of saving energy, reducing damage and increasing safety.

Heat transfer devices come in a great variety of shapes, sizes and designs to suit a multitude of purposes. The term "heat transfer devices" can be used to include both heaters and coolers, depending upon which way the heat is being transferred. Such Heat transfer devices often require energy to operate them. The source of such energy may include electricity, gas, oil or other known means. Whilst some heat transfer devices may have a very simple automatic control, many heat transfer devices have little more than manual control, especially in non-industrial situations. Whilst this is better than no control at all, manual control can suffer from a number of disadvantages. Whilst its setting at any time may be adjusted by a human operator, this operator often works on a series of guesses, based upon observations, which guesses are usually improved by experience. Damage can result in a variety of ways. For example, matter being cooled may freeze or matter being heated can be spoiled by being over heated, or the overheating can result in damage by the matter affecting its surroundings adversely, for example by boiling over or causing fire. Furthermore energy may be wasted and running costs increased. Whilst a simple automatic control may make some improvement over manual control, there are many problems that remain. Some controlling means, whilst acting automatically according to the state of the heat transfer system being controlled or of the environment or matter being affected by that heat transfer system, are not sufficiently advanced to process more accurate signals and so achieve a more effective control. One of the problems is a lack of devices that produce more accurate, and/or a greater number of, signals. Our patent application, GB 9614924.0, seeks to go some way towards this. Nor do many controllers, in non-industrial situations, have the capability of reacting to warning signals, or the like, nor are they capable of remote control. If the human controller is absent, in the case of a heat transfer device in the form of a hob that is heating a chip pan, for instance, damage can well arise from severe over heating and fire. Additionally, in this case and others, little provision is made for remote control. Where the use of a heat transfer device may be time dependent, but that time may vary, e.g. in the case of domestic central heating systems, or cooking hobs, where the timing may be dependent upon the time of arrival of a user, it would be very useful to have remote means for control. Other heat transfer devices to which the above remarks apply include some air conditioning and cooling systems. Additionally, many control systems do not provide an easy means of communicating with people who may be required for day to day operation or for maintenance and trouble shooting.

Hence, the invention seeks to solve these problems and to provide a heat transfer device controlled by a controller which has features in common with many controllers in other fields, such as securityand industry. With such a controller possessing versatility, safety and efficiency may be increased. Such a controller should have capabilities that include some, or all, of the following : monitoring the state of the heat transfer system being controlled or of the environment or matter being affected by that heat transfer system, reacting to warning signals, being controlled remotely, and better

of reduced energy consumption and risk of damage and increased safety.

Hence, it is necessary to provide a controller that can accept a variety of signals and act in the required manner. This may be to provide a greater degree of efficiency, effectiveness and safety than is, hitherto, usually provided by a human operator. The controller should be able to respond to different types of signal, that we shall divide, for convenience into data, warning and remote control signals. For programming purposes, the controller is provided with a keypad. Remote control signals can duplicate some or all of the programming action of the keypad. For example, data signals include those associated with the temperature of the matter being heated, within prescribed limits. These data signals may be acted upon by analogue and/or digital electronic circuitry, preferably programmable, so that the controller can produce more appropriate control signals. These signals will regulate the flow of energy to a heat transfer device so that desirable objects may be achieved. For example, a set temperature may be reached with an optimum balance between minimum time to reach the set point and minimum overshoot or, in the case of cooking, appropriate time/temperature programs mey be followed. On the other hand, warning signals are those that will also regulate the flow of energy to the heat transfer device but which demand a higher degree of priority than data signals. For example, they may be required to override the data signals and cause the controller to cut off the flow of energy completely. Warning signals include such signals as those from a smoke detector, the absence of a supervisor, or if the state of the heat transfer system being controlled or of the environment or matter being affected by that heat transfer system, fall outside prescribed limits. The controller must be capable of taking appropriate action. Another desirable attribute of an improved controller would be the ability of one model of controller to be used with several different types of heat transfer device, e.g. several different types of hob. This would improve the economics of mass production. In this case the ideal type of intelligent controller will be able to learn, automatically, about its particular system, and compensate for it. If we consider a controller fitted to a particular heat transfer device, then the thermal characteristics of the heat transfer device will be comparatively constant, but the system being affected by the heat transfer device may vary. For example, in cooking, such variability could arise from varying amounts of food in a cooking utensil, or for a particular air conditioning system, or central heating system, where the number of rooms to be heated or cooled can be varied. The intelligent controller will be programmed to learn about the system it is controlling, automatically, which parts are more or less constant, and which parts vary for any particular occasion. The more relevant the temperature signals that can be sent to the intelligent controller, in addition to the temperature of the matter being heated, the more the intelligent controller can learn about the system, the greater the likely accuracy. In the case of a kitchen hob, other temperature signals include a representative temperature of the vessel in which the matter is being heated, the temperature of part of the heater and the radiant temperature, that would indicate whether or not there is matter being heated. There may be other signals associated with physical quantities other than temperature, e.g. pressure. Another type of signal that might be important is that which will indicate whether or not a human operator is present. Such a situation usually occurs in the case of a domestic cooking hob, or equivalent commercial devices. Hitherto such devices have been manually controlled, also, the hob does not turn off or turn down when the cook is away for too long. Typical tragedies occur when a house burns down due to overheated frying utensils, chip pans and the like. Lesser tragedies involve the burning of food and the destruction of utensils. A further activity that can be carried out by an intelligent heater is energy management. It is useful, in this case, to retain the possibility of a degree of manual control, should this be required. Additionally, it will be useful to provide a means of communicating with people who may be required for day to day operation or for maintenance and trouble shooting. The invention needs, also, to provide means for

an operator.

According to the invention, these objects are accomplished in a controlled heat transfer means, in that the controlling means is adapted to accept a variety of input signals, to carry out calculations, as required, and to supply the necessary output signals to control the energy flow to the said heat transfer means in a more effective way.

In particular, the present invention concerns a controlled or controllable heat transfer device, in the control system of which is provided a higher degree of calculating power than used hitherto, in the sense that the controller is designed to receive and act on signals in such a way that any or all of the following may be effected: damage reduced, energy consumption reduced, safety increased, remote control programming made possible, better communication with an operator.

An object of the invention is to improve the designs of controllable heat transfer devices, by the addition of a more versatile programmable controller that can control the amount of heat being supplied to the hob, according to the state of the heat transfer system being controlled or of the environment or matter being affected by that heat transfer system, in other words, the state of the food being cooked. A further object of the invention is to make provision in the controller to accept signals that relate to a wider range of possibilities than the state of the state of the heat transfer system being controlled or of the environment or matter being affected by that heat transfer system, and cause the controller to act as required. Such signals include those that signal potential dangers such as the absence of a human operator or a dangerous level of smoke and signals that enable the heat transfer device to be operated remotely by remote programming of the controller. Further objects of the invention are to make provision in the controller for sufficient micro-electronics of known types so that the controller can carry out some or all of the following: learn about, and make allowance for, in terms of heat transfer characteristics, the type of hob it is controlling, the particular food/utensil combination being used at the time, use heating programs that may be supplied as an original package, or be created by the user, use algorithms designed to achieve the desired effect with minimum energy use and/or as quickly as possible, provide the possibility of remote control and remote programming, if required, and better communication with an operator..

According to the invention, a heat transfer apparatus is provided which comprises at least one heat transfer means and at least one programmable controller.

According to a further feature of the invention, said heat transfer means comprises a heater for cooking, commonly called a "hob".

According to a further feature of the invention, said programmable controller is adapted to receive at least one type of signal.

According to a further feature of the invention, there may be one or more separately controllable heaters.

According to a further feature of the invention, said programmable controller is adapted to control at least one of said separately controllable heater transfer means.

According to a further feature of the invention, at least one of said types of said received signal is a warning signal.

According to a further feature of the invention, at least one of said types of said received signal is a data signal.

According to a further feature of the invention, at least one of said received warning signals is generated by the absence of an operator.

warning signals is generated by a smoke detector.

According to a further feature of the invention, at least one of said received warning signals is generated by physical state of said heat transfer means falling outside prescribed limits.

According to a further feature of the invention, at least one of said received data signals is interpreted by said programmable controller as a temperature.

According to a further feature of the invention, at least one of said received data signals is interpreted as a level of energy supplied to at least one of said separately controllable heat transfer means.

According to a further feature of the invention, said programmable controller is adapted to generate at least one type of control signal.

According to a further feature of the invention, said control signal generated by said programmable controller is generated in response to one or more said received signals.

According to a further feature of the invention, at least one type of said control signal generated by said programmable controller controls the level of energy supplied to at least one of said separately controllable heat transfer means.

According to a further feature of the invention, at least one type of said control signal generated by said programmable controller provides an alarm signal.

According to a further feature of the invention, at least one type of said alarm signals is visual.

According to a further feature of the invention, at least one type of said alarm signals is audible.

Apparatus as claimed in Claim 16, characterised in that at least one type of said alarm signal controls the flow of energy to at least one of said heat transfer means.

According to a further feature of the invention, said programmable controller is provided with a visual display panel.

According to a further feature of the invention, said programmable controller is provided with a programming means.

Advantages provided by the invention include, the more complete and versatile control of heat transfer devices, in general, and hobs, in particular, leading to an ability to respond to various warning signals and hence to greater safety. In particular, such warning signals can include smoke detection, absence of a supervisor, overheating or overcooling, or more generally, where the state of the controlled heat transfer system falls outside prescribed limits.

Greater calculating power within the controller enables the state of the heat transfer device, and whatever is being heated or cooled, to be more effectively monitored, by measuring suitable physical quantities, that may include temperature and pressure and knowing how much energy is being supplied. Here, we distinguish between warning signals, required for safety purposes and data signals required for monitoring a physical quantity. The data signal may double as a warning signal, when the physical quantity being monitored, exceeds safe limits or falls outside prescribed limits. The calculations can take into account the actual state relative to it expected state. This increased calculating power leads to possibilities of more accurate control, energy saving and remote control by remote programming. As an example, for a hob with multiple rings, programmability and remote control and programming, it would be possible for the user to prepare a complete meal in advance, with cooking times and temperatures programmed in advance so that different parts of the cooking can be started and completed at the correct times even though those start and completion times may differ for each ring. The advantage of the remote control and programming is particularly valuable if timetables change, e.g. the time of the user's meal. In response to warning signals, such as form smoke, or overheating, or the absence of a supervisor, the controller is capable of a stepped response which, in the last resort, cuts the energy

central heating systems. The invention also provides for better communication with an operator..

The features of the different embodiments of the invention described above may be adopted singly or in combination. So that the invention may be more easily understood, an embodiment of the invention will be described with reference to the following schematic drawing :-
In the following description, the details do not necessarily conform to correct practices for safety etc. They are given purely for illustration.

Figure 1 shows a schematic diagram, in accordance with the invention, of a kitchen hob in plan view and a contoller front panel in elevation.

With reference to Figure 1, there is provided a hob, 1, which has 4 rings, 2, 3, 4 and 5. Each of said rings has a heater, of which only 2 are shown, items, 2' and 3'. For reasons of clarity, the control system for only the heater, 3', will be described. Further, for reasons of clarity, the best practices are not illustrated. e.g. item , 11, etc. to be described, would better switch both, items, 6, and, 7, to be described, and not just item, 7, as shown. However, the same principles apply to any or all of the other heaters to which this invention is fitted. Electrical power is delivered via lines item, 6, and item, 7. Control switches, 8, and, 9, are relays operated by a controller, 10. Item, 8, is connected to, 10, by lines 8' and 8" and item, 9, is connected to, 10, by lines 9' and 9". Said items, 8, and, 9, control the electrical power delivered to said heater, 3', according to signals received from controller, 10. A route alternative to item, 9, for controlling the electrical power to said heater, 3', is via a manual overide switch item, 11, which connects to, 3', via the more usual manual variable temperature control, 12. Input signals on lines, 13, 14, 15, 16, 17 and 18 provide signals which govern the behaviour of the controller, 10, depending upon the programming of the controller. In this example, lines 13, 14 and 15 carry temperature or pressure readings associated with the state of the ring, 3, and of the food, not shown, being cooked and of the vessel, not shown, containing the food being cooked and which may be of a type revealed in our patent application GB 9614924 0. Line 16, carries any signal from a smoke alarm, line 17, carries any signal that indicates the absence of an operator, and line 18, carries a remote control signal such as a modem might produce. Item 19 is a display panel of a known type, and item, 20, is a key pad of a known type. Item 20 is for controlling the display and/or the programming of the controller, 10. Signals on line 18, can duplicate some or all of the keypad features. Any signals on said lines, 16 and, 17, are associated with danger and safety. They are processed by the controller, 10, and suitable signals are sent to the heater, 3', via relay, 8. Should the signals on lines 13, 14 or 15, fall outside prescribed limits, such out of limit signals may be interpreted by the controller, 10, as warning signals and activate relay, 8. As wired in Figure 1, relay, 8, overides all the other controls, since safety must override everything else. Item, 19, can be used to display all sorts of useful information, depending upon the sequence of key presses it has received from item, 20. When the hob is not in use, it might simply show the time. It could also carry timed or other reminders or warnings of a more general nature. Preferably, each display will show some menu or prompt, to help the user achieve the ends they require. If the switch, 8 , has been activated, the display panel may indicate the reason and the time. The reasons for activating switch, 8 , could include, Smoke Alarm, Hob Left Unattended, Food Overheating etc. Should the normal type of controller, 12, be activated by the setting of switch, 11, then the Display might read, "Under Manual control".

What we claim is:

1. A heat transfer apparatus comprising at least one heat transfer means and characterised by at least one programmable controller.
2. Apparatus as claimed in Claim 1, characterised in that said heat transfer means comprises a type of heater for cooking, commonly called a "hob"
3. Apparatus as claimed in Claim 1, characterised in that said programmable controller is adapted to receive at least one type of signal.
4. Apparatus as claimed in Claim 1 or Claim 2, characterised in that there may be one or more separately controllable heat transfer means.
5. Apparatus as claimed in Claim 1 and Claim 4, characterised in that said programmable controller is adapted to control at least one of said separately controllable heat transfer means.
6. Apparatus as claimed in Claim 3, characterised in that at least one of the types of said received signal is a warning signal.
7. Apparatus as claimed in Claim 3, characterised in that at least one of said types of said received signal is a data signal.
8. Apparatus as claimed in Claim 6, characterised in that at least one of the types of said warning signals is generated by the absence of an operator.
9. Apparatus as claimed in Claim 6, characterised in that at least one of the types of said warning signals is generated by a smoke detector.
10. Apparatus as claimed in Claim 6, characterised in that at least one of the types of said warning signals is generated by physical state of said heat transfer means falling outside prescribed limits.
11. Apparatus as claimed in Claim 7, characterised in that at least one of said received data signals is interpreted by said programmable controller as a temperature.
12. Apparatus as claimed in Claim 7, characterised in that at least one of said received data signals is interpreted as a level of energy supplied to at least one of said separately controllable heat transfer means.
13. Apparatus as claimed in Claim 1, characterised in that said programmable controller is adapted to generate at least one type of control signal.
14. Apparatus as claimed in Claim 13, characterised in that said control signal generated by said programmable controller is generated in response to one or more said received signals.
15. Apparatus as claimed in Claim 14, characterised in that at least one type of said control signal generated by said programmable controller controls the level of energy supplied to at least one of said separately controllable heat transfer means.
16. Apparatus as claimed in Claim 14, characterised in that at least one type of said control signal generated by said programmable controller provides an alarm signal.
17. Apparatus as claimed in Claim16, characterised in that at least one type of said alarm signals is visual.
18. Apparatus as claimed in Claim 16, characterised in that at least one type of said alarm signals is audible.
19. Apparatus as claimed in Claim 16, characterised in that at least one type of said alarm signal controls the flow of energy to at least one of said heat transfer means.
20. Apparatus as claimed in Claim 1, characterised in that said programmable controller is provided with a visual display panel.
21. Apparatus as claimed in Claim 1, characterised in that said programmable controller is provided with a programming means.
22. Apparatus as claimed in Claim 3, characterised in that one of the types of said received signal may be a remote signal.

The Patent Office

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Application No: GB 9622086.8 **Examiner:** David Mobbs
Claims searched: 1-22 **Date of search:** 12 December 1996

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.O): G3N NGBC1, NGK2, NGL, NG1A1, NG1A3, NG1A5, NG1A9, NG1AX;
G3R RBQ42.

Int Cl (Ed.6): F24C 7/08.

Other: NONE.

Documents considered to be relevant:

Category	Identity of document and relevant passage		Relevant to claims
X, Y	GB 2,298,936 A	(KWEI TANG CHANG)	X: 1, 3, 7, 10-11, 13-16, 18, 20-21. Y: 2, 4-6, 8-9, 12, 17, 19, 22.
X	GB 2,264,370 A	(KABUSHIKI KAISHA TOSHIBA)	1, 3, 7, 13-15, 20-21.
Y	GB 2,252,846 A	(WAYNE BECK JOHN)	1, 3-5, 7, 11-14, 20-22.
X, Y	GB 2,073,455 A	(APPLIANCE CONTROL SYSTEMS PTY. LTD.)	X: 1, 3, 7, 10-16, 18-22. Y: 2, 4-6, 8-9, 17.

X Document indicating lack of novelty or inventive step
Y Document indicating lack of inventive step if combined with one or more other documents of same category.
& Member of the same patent family
A Document indicating technological background and/or state of the art.
P Document published on or after the declared priority date but before the filing date of this invention.
E Patent document published on or after, but with priority date earlier than, the filing date of this application.

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Application No: GB 9622086.8 **Examiner:** David Mobbs
Claims searched: 1-22 **Date of search:** 12 December 1996

Category	Identity of document and relevant passage		Relevant to claims
Y	EP 0,619,568 A	(WHIRLPOOL CORPORATION)	1-7, 10-11, 13-16, 18-19.
X, Y	EP 0,285,056 A	(FOOD AUTOMATION-SERVICE TECHNIQUES INC.)	X: 1, 3-7, 13-22. Y: 2, 8-12.
Y	WO 89/08300 A	(BIRGING et. al.)	1, 3, 6, 10.
Y	US 4,659,909	(KNUTSON)	1, 3, 6, 9.

X Document indicating lack of novelty or inventive step
Y Document indicating lack of inventive step if combined with one or more other documents of same category.
& Member of the same patent family
A Document indicating technological background and/or state of the art.
P Document published on or after the declared priority date but before the filing date of this invention.
E Patent document published on or after, but with priority date earlier than, the filing date of this application.